Score Jacobian Chaining: Lifting Pretrained 2D Diffusion Models for 3D Generation

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Abstract

A diffusion model learns to predict a vector field of gradients. We propose to apply chain rule on the learned gradients, and back-propagate the score of a diffusion model through the Jacobian of a differentiable renderer, which we instantiate to be a voxel radiance field. This setup aggregates 2D scores at multiple camera viewpoints into a 3D score, and re-purposes a pretrained 2D model for 3D data generation. We identify a technical challenge of distribution mismatch that arises in this application, and propose a novel estimation mechanism to resolve it. We run our algorithm on several off-the-shelf diffusion image generative models, including the recently released Stable Diffusion trained on the large-scale LAION 5B dataset.